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AUTHOR Hiebert, Clyde
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ABSTRACT

For various reasons, students do not have access to laboratory facilities and yet need courses in the laboratory sciences such as chemistry. This paper describes "Outreach Chemistry," a course developed to provide a chemistry laboratory experience for students attending schools that lack science laboratories. Designed for off-campus students whose work schedules make enrollment in laboratory courses taught on the main campus difficult, this course is taught in a regular classroom, while maintaining the same lecture material as the chemistry courses taught on main campus. The laboratory segment of the course is composed of 23 experiments that require minimal equipment. The management of the necessary equipment is described and the advantages and disadvantages of this method of teaching chemistry are discussed. A list of the 23 experiments is provided. (MDH)

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ED 406 129

TEACHING CHEMISTRY IN THE CLASSROOM WITHOUT THE TRADITIONAL LABORATORY: "OUTREACH CHEMISTRY"

by

Clyde Hiebert
Butler County Community College
El Dorado, Kansas 67042

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The purpose of developing the Outreach Chemistry, was to offer the adult student an opportunity to take a course in chemistry. Most of them find it impossible to travel to our main campus during either the day or evening, to take a laboratory course. By designing a mobile course, our department gave them the opportunity to experience a course in chemistry. We wanted to offer a quality program without having to rely on an expensive laboratory facility and we are confident that we have accomplished this goal.

HAVE KIT WILL TRAVEL

Teaching a laboratory science in a classroom is not a new idea. Several years ago, Dr. Hubert N. Alyea of Princeton University developed "Armchair Chemistry."(1) The purpose of his course was to provide a chemistry laboratory experience for students attending schools which lack laboratory facilities, i.e. universities with large freshmen chemistry classes and colleges in underdeveloped countries lacking funds. His work was the inspiration for the development of our "Outreach Chemistry". This course can be taught in a regular classroom, eliminating the need for the construction of an expensive laboratory. In addition, the cost for supplies for teaching chemistry with this approach is much less, a few cents per student compared to dollars. A conservative estimate is that it costs about $3.00 per student per semester for supplies.

Butler County Community College like many other community colleges, has a rather extensive off-campus program. The off-campus students have been able to pursue many different career choices and have also been able to take most courses required for graduation with the exception of a laboratory science. Since most off-campus students work full time, their schedule between work and school often conflict; therefore it is practically impossible for them to enroll in a laboratory science taught on the main campus during the day. Likewise to travel a distance of approximately 60 miles round trip to attend an evening class is also impractical for most off-campus students. There was a definite need to develop a course that could be taken to the student.

It was decided to modify Dr. Alyea's course for our basic chemistry students. As a result, a similar course was developed and called " Outreach Chemistry." The objective of this basic chemistry course is to reach students who have never taken chemistry or to offer a refresher course for those

desiring one. The lecture material presented to the outreach chemistry classes is the same as that given to the basic chemistry classes taught on campus. The difference lies in the laboratory exercises. Conducting laboratory experiments in a regular classroom, does have a limitation. For example, those experiments which give off obnoxious fumes cannot be conducted. Keeping this in mind, and also recognizing that the purpose of laboratory exercises should reinforce material covered in the lecture section, our department searched during the spring of 1981 for experiments of this kind. A series of 23 experiments has been compiled,(2) and placed on computer disc, along with a list of supplies and equipment needed for each experiment. Laboratory excersises can be printed from the computer and copies duplicated for the students.

In the classroom minimal equipment is required. First a source of tap water and a sink (A restroom will suffice) are necessary. Also a place to house equipment and materials is needed. For the latter requirement, three 6'x 3' metal cabinets are available . Chemical supplies, such as solutions are kept in plastic dropping bottles and solids in small plastic bottles. For heat sources, alcohol lamps and electric hot plates are used. Originally, small inexpensive double pan balances were used for weighing. These have been replaced with one electronic, digital read-out, single pan balance. This has greatly reduced the level of frustration for the students. Large plastic beakers are available for disposing of liquid materials, used during a laboratory exercise and which are later poured down the sink. Deionized water is transported from the main campus in a three gallon plastic container and then dispensed through squeeze bottles.

The actual procedure is simple. All students from different class sections use the same equipment and supplies. Supplies needed for a given experiment are taken from the cabinets and set out on a table . Students then pick up

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what is needed and take materials to their desks, where they perform the experiment . They are allowed to work in a group of two to four students. Each student turns in a report on the experiment the following class session.

There are at least two advantages for using this approach to teaching chemistry. One, there is a minimum amount of time needed for laboratory preparation. Initially it required five days, labeling and filling 1600 bottles (many of which have not had to be refilled) for approximately one hundred students. Since that time, three to four hours of work in the fall is all that is needed to prepare materials for the entire year. Of course, during the semester some special reagents are needed, but these only require a few days advance planning, so that they will be ready when needed for transport. A second advantage, is cost. As noted above, the cost is pennies compared to dollars spent in using the conventional approach for teaching a chemistry laboratory course.

Overall, this method has been a satisfactory one. This course has undergone some changes since its inception from the fall of 1981. Some experiments did not work out, and replacements have been found. Additional experiments that require an ordinary kitchen or research in a library, have been compiled. Also several computer simulated laboratory excersises are also being used.
To date over 1000 students have completed the course. At first it was taught exclusivley at McConnel Air Force Base. We now have added two sections of the course at another outreach location, Andover, Kans.
Base. The students appear to enjoy the laboratory exercises and are not overwhelmed by complex-looking apparatus. They relax and help each other learn, which is the "name of the game." Some students have gone on to more advanced chemistry courses such as Chem I and elementary organic, and have been successful. Apparently, the lack of sophisticated equipment in the first course does not seem to hinder them. Two class session of three hours each are held

per week for sixteen weeks. A lecture of an hour or more followed by a laboratory exercise is the usual procedure for each session. The course is designed for the non-major student and is in no way intended to replace the real lab requred to teach intensive chemistry.

The conclusion that has been reached is that a quality laboratory course in chemistry can be taught without building an expensive laboratory. There is no reason this course could not be modified to be taught in any school. Any high school, college, regardless of how large or small, wealthy or poor, can offer its students a laboratory chemistry course.

(1) Alyea, Hubert N. 1971. "Armchair Chemistry." Princeton, University.

(2) Experiments:

- Metric System
- Heat Effects
- Dulong and Pettit
- Physical Properties-Alyea
- Sand-Salt Mixture
- Properties of Matter and Change
- A Study of Reactions
- Survey of Chemical Reactions
- Corrosion of Iron
- A Study of Reaction Rates
- Oxides and Water
- Progressive Precipitation
- Unknown Hydrate
- pH Using Indicators
- Boyle's Law and Absolute Zero
- Molecular Mass of a Gas
- Melting Point of a Pure Substance
- Heat of Reaction
- Standardizing a Solution
- Analysis of Ammonia Solution and Vinegar
- Molecular Mass of Sulfur
- Percent Potassium Chlorate in Impure Sample
- Reaction of Metals